

same in a telephoto state; FIG. 7 is an exploded perspective view of a portion of the lens barrel in the wide-angle state; and FIG. 8 is an exploded perspective view of the portion of the lens barrel in the telephoto state.

Since the lens barrel according to the second embodiment has substantially the same structure as the aforementioned lens barrel according to the first embodiment, the same members are only designated the same reference numerals, and a detailed description thereof is omitted for the sake of brevity.

A flare diaphragm 12 is formed by a flexible material having light shielding and elastic properties such as silicon rubber or the like. The flare diaphragm 12 is formed in a semicircular hollow disk shape having a flat surface perpendicular to the optical axis O as illustrated in FIG. 8.

The outer periphery 12a of the flare diaphragm 12 is secured to the inner surface of a fixed frame 1. This secured position is opposite to a cam surface 4d when a second lens frame 4 is in a wide-angle position. The flare diaphragm 12 has a free end on the inner peripheral side, and a diaphragm edge 12b is formed at a position nearer to the optical axis beyond the outer periphery of the second lens frame 4.

When the lens barrel is in the wide-angle state, the cam surface 4d of the second lens frame 4 is positioned inside and to the right of the flare diaphragm 12, as illustrated in FIGS. 5 and 7. The cam surface 4d and the outer periphery of the second lens frame 4 deform and enlarge the diaphragm edge 12b of the flare diaphragm 12. In this state, a wide light beam 9 reaches a predetermined position on a film 8 without any obstacle.

When a cam ring 2 is rotated to advance a first lens frame 3 and the second lens frame 4 to a telephoto position, the cam surface 4d of the second lens frame 4 moves forward from the inside of the flare diaphragm 12, so that the diaphragm edge 12b of the flare diaphragm 12 becomes free.

In this state, while a telephoto light beam 10 can pass inside the diaphragm edge 12b and reach the film 8, a deleterious light beam 11 is blocked by the flare diaphragm 12 so that it cannot reach the film 8.

In the lens barrel according to the second embodiment structured as described above, since the flare diaphragm can be formed of a single sheet-like member, a manufacturing cost can be reduced.

While in the second embodiment, the flare diaphragm 12 is disposed only in an upper half portion of the lens barrel, it goes without saying that one flare diaphragm may be disposed in a lower half portion or two flare diaphragms may be disposed in both of the upper and lower portions.

Next, a third embodiment of the lens barrel according to the present invention will be described with reference to FIGS. 9-11. FIG. 9 is a cross-sectional view illustrating the lens barrel according to the third embodiment which is in a wide-angle state; FIG. 10 is a cross-sectional view of the lens barrel in a telephoto state; and FIG. 11 is an exploded perspective view of a portion of the lens barrel in the telephoto state.

Since the lens barrel according to the third embodiment has substantially the same structure as the lens barrels of the aforementioned first and second embodiments, the same members are designated by the same reference numerals, and a detailed description thereof is omitted.

A flare diaphragm 13 is formed by a flexible material having light shielding and elastic properties, such as, for example, a black light shielding polyester sheet. The flare diaphragm 13 is formed in a substantially rectangular shape

having a flat surface perpendicular to the optical axis O, and arc-shaped upper and lower sides, as illustrated in FIG. 11.

The outer periphery 13a of the flare diaphragm 13 is secured to the inner surface of a fixed frame 1. This secured position is opposite to a cam surface 4d in a second lens frame 4 when the second lens frame 4 is in a wide-angle position. The flare diaphragm 13 has a free end on the inner peripheral side, and a diaphragm edge 13b is formed at a position nearer to the optical axis beyond the outer periphery of the second lens frame 4, when it is free.

When the lens barrel is in the wide-angle state, the second lens frame 4 is positioned inside and to the left of the flare diaphragm 13 as illustrated in FIG. 9. The rear end surface of the second lens frame 4 urges the diaphragm edge 13b of the flare diaphragm 13 rearwards to urge the flare diaphragm 13 into a curved shape such that the diaphragm edge 13b is retreated outside the optical path of the lens. In this state, a wide light beam 9 reaches a predetermined position on a film 8 and is focused thereon without any obstacle.

When a cam ring 2 is rotated to advance a first lens frame 3 and the second lens frame 4 to a telephoto position, the rear end surface of the second lens frame 4 moves forwards beyond the flare diaphragm 13. Thus, the diaphragm edge 13b of the flare diaphragm 13 becomes free.

In this state, while a telephoto light beam 10 can pass inside the diaphragm edge 13b and reach the film 8, a deleterious light beam 11 is blocked by the flare diaphragm 13 and cannot reach the film 8.

In the lens barrel according to the third embodiment structured as described above, since the flare diaphragm 13 can be formed of a single sheet-like member, a manufacturing cost can be reduced.

FIG. 19 is a modification of the third embodiment showing how deleterious light 11' may be eliminated by flare diaphragm 13' which is disposed on the lower side of the optical axis O.

Next, a fourth embodiment of the lens barrel according to the present invention will be described with reference to FIGS. 12-14. FIG. 12 is a cross-sectional view illustrating the lens barrel according to the fourth embodiment which is in a wide-angle state; FIG. 13 is a cross-sectional view of the lens barrel in a telephoto state; and FIG. 14 is an exploded perspective view of a portion of the lens barrel.

Since the lens barrel according to the fourth embodiment has substantially the same structure as the lens barrels of the aforementioned first-third embodiments, the same members are designated by the same reference numerals, and a detailed description thereof is omitted.

A flare diaphragm 14 has a supporting hole 14a into which a shaft 15 is rotatably inserted. This shaft 15 is fixed to a fixed frame 1, so that the flare diaphragm 14 is rotatably supported by the fixed frame 1. A cam follower 14b of the flare diaphragm 14 is inserted into a flare diaphragm cam 2c of a cam ring 2 through an escape groove 1d formed through the fixed frame 1. In addition, an arc-shaped diaphragm edge 14c as illustrated in FIG. 14 is formed in the flare diaphragm 14 on the side opposite to the cam follower 14b and the supporting hole 14a.

On the outer periphery of the cam ring 2, a gear 2d is disposed along the circumferential direction and is coupled to an output shaft 17 of a zoom motor 18 through a driving gear 16.

The cam follower 14b of the flare diaphragm 14 is positioned at a wide-side end of the flare diaphragm cam 2c of the cam ring 2 as illustrated in FIG. 12. Since the flare

diaphragm 14 is rotated about the shaft 15 in the counter-clockwise direction, the diaphragm edge 14c of the flare diaphragm 14 is retreated outside the optical path, where a wide light beam is not blocked. The wide light beam 9 therefore reaches a film 8 without any obstacle.

When the cam ring 2 is rotated by zoom motor 18 to advance the first lens frame 3 and the second lens frame 4 in the direction of the optical axis to the positions indicated in FIG. 13, the lens barrel is in a telephoto state. During this operation, the cam follower 14b of the flare diaphragm 14 is retreated from a wide position indicated by W in FIG. 14 to a telephoto position indicated by T in FIG. 14 in the flare diaphragm cam 2c. This causes the flare diaphragm 14 to rotate about the shaft 15 in the clockwise direction from the state illustrated in FIG. 12 until the diaphragm edge 14c reaches near the rear end surface of the second lens frame 4, as illustrated in FIG. 13.

In this state, a telephoto light beam 10 passes near the lower end of the diaphragm edge 14c and reaches the film 8. However, a deleterious light beam 11 having a large emitting angle is cut by the flare diaphragm 14 and does not reach the film 8.

In this flare diaphragm 14, since the timing of advancing into and retreating from the optical path can be arbitrarily set by the shape of the flare diaphragm cam 2c formed through the cam ring 2, the position of the flare diaphragm 14 can be set in accordance with a change in focal distance, thereby making it possible to more effectively cut deleterious light beams.

Next, a fifth embodiment of the lens barrel according to the present invention will be described with reference to FIGS. 15-18. FIG. 15 is a cross-sectional view illustrating the lens barrel according to the fifth embodiment which is in a wide-angle state; FIG. 16 is a cross-sectional view illustrating the lens barrel in a telephoto state; FIG. 17 is an exploded perspective view of a portion of the lens barrel; and FIG. 18 is a cross-sectional view of a portion of the lens barrel.

Since the lens barrel according to the fifth embodiment has substantially the same structure as the aforementioned first-fourth embodiments, the same members are designated by the same reference numerals, and a detailed description thereof is omitted.

A flare diaphragm 19 is pivotably supported by a shaft 20 which is fixed to a fixed frame 1. The outer periphery of a portion of the flare diaphragm 19, into which the shaft 20 is inserted, is formed with a gear 19a. The gear 19a is meshed with a worm gear 21 rotatably projecting from the flange 1b of the fixed frame 1.

An arc-shaped diaphragm edge 19b is formed at the lower end of the flare diaphragm 19, as illustrated in FIG. 17.

A diaphragm gear 22 is fixed coaxially with a coupling shaft 21a of the worm gear 21 at the back of the worm gear 21 beyond flange 1b. The diaphragm gear 22 is rotatably supported by the fixed frame 1, and meshed with a smaller diameter gear of a first coupling gear 23 rotatably supported by the flange 1b. Further, a larger diameter gear of the first coupling gear 23 is meshed with a smaller diameter gear of a second coupling gear 24 rotatably supported above the first coupling gear 23, while a larger diameter gear of the second coupling gear 24 is meshed with a smaller diameter gear of a third coupling gear 25 rotatably supported above the second coupling gear 24. Further, a larger diameter gear of the third coupling gear 25 is provided with a coupling shaft 25a extending through the flange 1b, and a driving gear 25b, meshed with a gear 2d formed around the outer periphery of

a cam ring 2, is disposed at the front of the coupling shaft 25a. A larger diameter gear of the third coupling gear 25 is meshed with an output gear 27 coupled to an output shaft 26a extending from a motor 26.

Stated another way, the above-mentioned first coupling gear 23, second coupling gear 24, and third coupling gear 25 form a transmission gear train for transmitting a driving force from the motor 26 to the gear 19a of the flare diaphragm 19 and to the gear 2d of the cam ring 2.

A disk-shaped light shielding plate 28 formed with teeth around the periphery is disposed on the output shaft 26a of the motor 26, such that a driving amount of the motor 26 can be monitored by detecting the teeth of the light shielding plate 28 by a photo-interrupter 29.

Also, as illustrated in FIG. 18, the flare diaphragm 19 and the worm gear 21 are accommodated in a space provided by cutting a second lens frame 4 and a second lens group L2 in an oval shape.

In a wide-angle state as illustrated in FIG. 15, the flare diaphragm 19 is in a posture substantially parallel with the optical axis O. In this state, the flare diaphragm 19 is accommodated in the space provided by cutting the second lens frame 4 in an oval shape.

In the wide-angle state, the flare diaphragm 19 is rotated to a position substantially parallel with the optical axis, as illustrated. The diaphragm edge 19b is completely retreated from the optical path of the photographic optical system, so that a wide light beam 9 reaches a film 8.

In this state, as the motor 26 is rotated, the photo-interrupter 29 detects the rotation of the motor 26 to drive the cam ring 2 from the rotating position in the wide-angle state to a rotating position in a telephoto state. A driving force of the motor 26 is also transmitted to the worm gear 21 through the above-mentioned first coupling gear 23, second coupling gear 24, third coupling gear 25, and the diaphragm gear 22, whereby the flare diaphragm 19 is rotated about the shaft 20 in the counter-clockwise direction, so that the diaphragm edge 19b is moved behind the rear end surface of the second lens frame 4 as illustrated in FIG. 16.

In this state, while the telephoto light beam 10 passes below the diaphragm edge 19b and reaches the film 8, a deleterious light beam 11 having a large emitting angle is cut by the flare diaphragm 19 so that it does not reach the film 8.

In the fifth embodiment described above, the use of the motor ensures that the flare diaphragm can be driven. In addition, since the flare diaphragm and a portion of the mechanism required for the driving are disposed in the space provided by cutting the lens in an oval shape, the lens barrel can be reduced in size.

Generally, when a camera is positioned horizontally, the sun light is incident from the above. That is, the sun light is incident from an upper portion of the front end of the lens barrel and exits the lens barrel in a lower rear direction. It is therefore more effective if the flare diaphragm is disposed in a lower rear portion of the lens barrel. While the aforementioned respective embodiments have shown an example in which the flare diaphragm is disposed only in the upper half of the lens barrel, it goes without saying that the flare diaphragm may be disposed only in the lower half, or may be disposed in both of the upper half and the lower half.

What is claimed is:

1. A lens barrel comprising:

a moveable flare diaphragm disposed on an optical path of lenses or in a vicinity thereof such that said flare

diaphragm respectively, advances in a direction toward and retreats in an opposite direction away from the optical path for cutting deleterious light responsive to said lenses moving in a projecting direction and a collapsing along an optical axis.

2. A lens barrel according to claim 1, wherein said flare diaphragm is adapted to advance and retreat responsive to a respective change in focal distance of said lens.

3. A lens barrel according to claim 1, wherein a moveable lens frame is used as a driving source for moving said flare diaphragm.

4. A lens barrel according to claim 3, wherein said movable lens frame has a cam surface and said flare diaphragm has a cam follower moved by said cam surface.

5. A lens barrel according to claim 1, wherein said flare member includes a cam follower engaging a cam provided in said lens barrel to move said flare diaphragm.

6. A lens barrel according to claim 1, wherein at least one point along the flare diaphragm remains stationary and another portion thereof moves into and out of the optical path.

7. The lens barrel according to claim 1, wherein the flare diaphragm moves along an arcuate path.

8. The lens barrel according to claim 1, wherein the flare diaphragm swings about a fixed pivot point.

9. A lens barrel comprising:

a flare diaphragm disposed on an optical path of lenses or in a vicinity thereof such that said flare diaphragm advances into and retreats from the optical path for cutting deleterious light responsive to said lenses moving in a direction of an optical axis,

wherein a driving motor for driving said lenses for zooming or focusing is used as a driving source of said flare diaphragm.

10. A lens barrel according to claim 9, wherein said flare member is swingably mounted about a pivot axis and further including gear means coupled between said driving motor and said flare diaphragm for moving said flare diaphragm during operation of said driving motor.

11. A lens barrel comprising:

a flare diaphragm disposed on an optical path of lenses or in a vicinity thereof such that said flare diaphragm advances into and retreats from the optical path for cutting deleterious light responsive to said lenses moving in a direction of an optical axis,

wherein said flare diaphragm is formed by a flexible member.

12. A lens barrel comprising:

a flare diaphragm disposed on an optical path of lenses or in a vicinity thereof such that said flare diaphragm advances into and retreats from the optical path for cutting deleterious light responsive to said lenses moving in a direction of an optical axis,

wherein said flare diaphragm is disposed in a space of D-shaped cut portion in the lenses which does not contribute to an effective light beam.

13. A lens barrel comprising:

a flare diaphragm disposed on an optical path of lenses or in a vicinity thereof such that said flare diaphragm advances into and retreats from the optical path for cutting deleterious light responsive to said lenses moving in a direction of an optical axis,

wherein said flare diaphragm is disposed only on a lower side of the optical axis in a rear portion of said lens barrel.

14. A lens barrel comprising:

a flare diaphragm disposed on an optical path of lenses or in a vicinity thereof such that said flare diaphragm advances into and retreats from the optical path for cutting deleterious light responsive to said lenses moving in a direction of an optical axis,

wherein said flare diaphragm has a center of rotation orthogonal to the optical axis, and advances into and retreats from the optical path by a rotating operation corresponding to a position of the lenses.

15. A lens barrel comprising:

lenses forming a photographic optical system;

a lens holding frame for holding said lenses, said lens holding frame being moved in a direction of an optical axis to perform a focal distance changing operation or a focusing operation for the photographic optical system; and

a moveable flare diaphragm respectively, advanced in a direction toward and retreated in an opposite direction away from a photographic optical path for cutting deleterious light in response to movements of said lens holding frame in opposite directions along the optical axis.

16. A lens barrel according to claim 15, wherein said flare diaphragm is disposed only on a lower side of the optical axis in a rear portion of said lens barrel.

17. A lens barrel according to claim 15, wherein at least one point along the flare diaphragm remains stationary and another portion thereof moves into and out of the optical path.

18. A lens barrel according to claim 15, wherein said flare diaphragm is advanced and retreated by movements of said lens holding frame in the direction of the optical axis caused by a change in focal distance of said lenses.

19. A lens barrel comprising:

lenses forming a photographic optical system;

a lens holding frame for holding said lenses, said lens holding frame being moved in a direction of an optical axis to perform distance changing operation or a focusing operation for photographic optical system;

a flare diaphragm advanced into and retreated from a photographic optical path for cutting deleterious light in response to movements of said lens holding frame in the direction of the optical axis,

wherein a driving motor for driving said lenses for zooming or focusing is used as a driving source of said flare diaphragm.

20. A lens barrel comprising:

lenses forming a photographic optical system;

a lens holding frame for holding said lenses, said lens holding frame being moved in a direction of an optical axis to perform a focal distance changing operation or a focusing operation for the photographic optical system; and

a flare diaphragm advanced into and retreated from a photographic optical path for cutting deleterious light in response to movements of said lens holding frame in the direction of the optical axis,

wherein said flare diaphragm is formed by a flexible member.

21. A lens barrel comprising:

lenses forming a photographic optical system;

a lens holding frame for holding said lenses, said lens holding frame being moved in a direction of an optical

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axis to perform a focal distance changing operation or a focusing operation for the photographic optical system; and

- a flare diaphragm advanced into and retreated from a photographic optical path for cutting deleterious light in response to movements of said lens holding frame in the direction of the optical axis, 5

wherein said flare diaphragm is disposed in a space of a D-shaped cut portion in the lenses which does not contribute to an effective light beam. 10

22. A lens barrel comprising:

lenses forming a photographic optical system;

- a lens holding frame for holding said lenses, said lens holding frame being moved in a direction of an optical axis to perform a focal distance changing operation or a focusing operation for the photographic optical system; and 15

- a flare diaphragm advanced into and retreated from a photographic optical path for cutting deleterious light in response to movements of said lens holding frame in the direction of the optical axis, 20

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wherein said flare diaphragm swings about a center of rotation orthogonal to the optical axis, and advances into and retreats from the optical path by rotating operations corresponding to a position of the lenses.

23. A lens barrel comprising:

a flare diaphragm disposed on an optical path of lenses or in the vicinity thereof such that said flare diaphragm advances into and retreats from the optical path for cutting deleterious light corresponding to said lenses moving in a direction of an optical axis,

wherein a moveable lens frame is used as a driving source for moving said flare diaphragm, and

wherein said flare diaphragm is formed by a flexible member, said movable lens frame having a cam surface for selectively engaging said flexible member responsive to a relative position of the movable lens frame along the optical axis.

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